

High Demand Questions

QUESTIONSHEET 1

- (a) Crude oil is the raw material of the petrochemical industry. Describe how crude oil was formed.

.....

.....

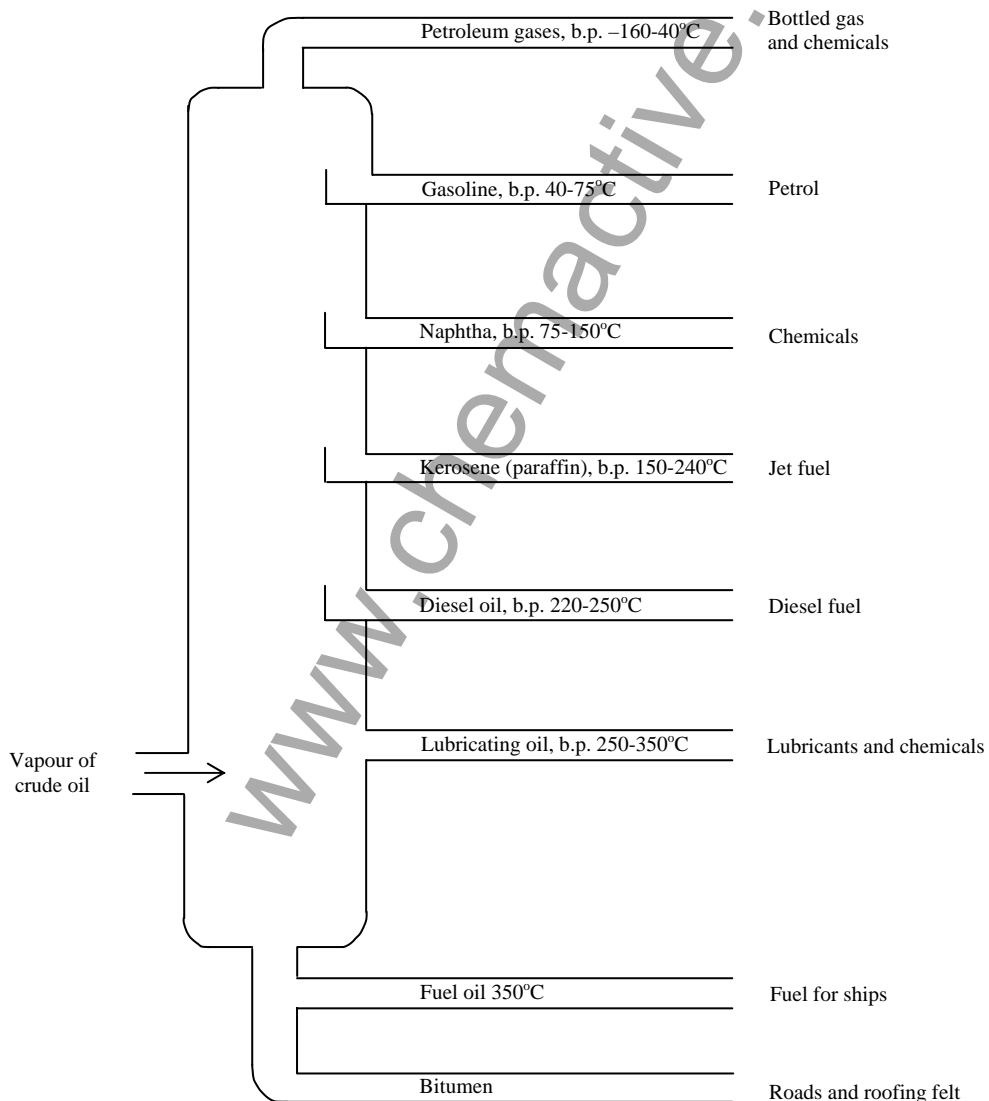
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.....

.....

..... [3]

- (b) The first stage in the processing of crude oil is fractional distillation. The process is illustrated in the diagram below.



(Continued...)

QUESTIONSHEET 1 CONTINUED

- (i) Explain how fractional distillation can be used to separate crude oil.

.....
.....
.....
..... [3]

- (ii) From which fraction is petrol obtained?

..... [1]

- (iii) Which fraction provides the chemical feedstock for the petrochemical industry?

..... [1]

- (c) All of the chemicals in crude oil are hydrocarbons. What are hydrocarbons?

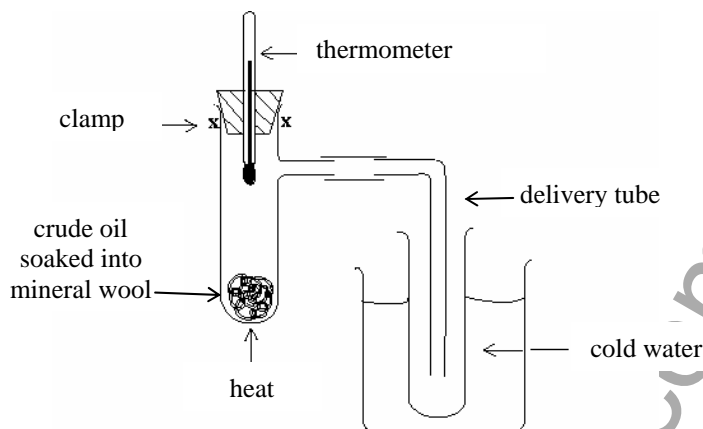
..... [2]

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QUESTIONSHEET 2

Crude oil is a mixture of many different hydrocarbons. The process by which it can be separated can be demonstrated in the laboratory using the apparatus shown below.



- (a) (i) What is the name for this process of separation?

..... [1]

- (ii) What is the purpose of the mineral wool?

..... [1]

- (b) In a typical experiment, four different fractions can be collected. The properties of these fractions are summarised below.

fraction	b.p. range (°C)	viscosity	colour	how it burns
A	up to 80	very low	colourless	easily clean flame
B	80 to 160	low	pale yellow	quite easily smoky flame
C	160 to 250	high	yellow	difficult to light very smoky flame
D	250 to 320			

Complete the table.

[3]

- (c) Suggest, with reasons, which fraction would be used to provide:

- (i) fuel for a motor car engine.

Fraction [1]

Reason..... [2]

- (ii) a lubricating oil.

Fraction [1]

Reason..... [1]

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High Demand Questions

QUESTIONSHEET 3

Many of the hydrocarbons obtained from crude oil belong to the alkane homologous series.

(a) What is a hydrocarbon?

..... [2]

(b) State **two** general characteristics of any homologous series.

.....
..... [2]

(c) The first and fourth members of the alkane series are methane, CH_4 , and butane, C_4H_{10} .
What is the formula of hexane, the sixth member of the series?

..... [1]

(d) The atoms of the hydrocarbon, C_4H_{10} , can be arranged in two different ways.

(i) Draw the structural formulae for the two arrangements of this hydrocarbon.

[2]

(ii) Which of the two structural formulae you have drawn will have the higher boiling point?

..... [1]

(iii) Explain your answer to part (ii).

.....
.....
..... [2]

High Demand Questions

QUESTIONSHEET 4

Crude oil is a mixture of many compounds. In order to convert it into useful products it must pass through a number of processes.

- (a) One of the products of the first processing stage is naphtha.
What is the name of the process by which naphtha is produced?

..... [1]

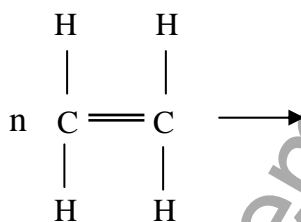
- (b) Naphtha is then subjected to another process that can produce ethene as one of the products.
What name is given to this process?

..... [1]

- (c) Ethene can be used for a number of other processes, one of which makes poly(ethene).
What is the name of this process?

..... [1]

- (d) Complete the following structural equation for the formation of poly(ethene).



- (e) Describe **two** environmental problems which are associated with the disposal of waste plastics.

..... [2]

High Demand Questions

QUESTIONSHEET 5

This question is about the alkene, ethene, C_2H_4 , which is an unsaturated hydrocarbon.

- (a) What is meant by 'unsaturated'?

..... [1]

- (b) What is the general formula of alkenes?

..... [1]

- (c) Ethanol can be produced from ethene by direct hydration.



Under what conditions is this reaction carried out?

.....
..... [2]

- (d) Draw the structural formula of ethanol

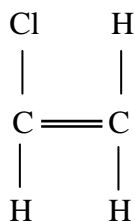
[1]

- (e) Ethane is a saturated hydrocarbon.

Describe a simple test that would enable you to distinguish between ethene and ethane.

.....
..... [2]

- (f) Chloroethene (vinyl chloride) can be made from ethene.



Chloroethene can be used to produce poly(chloroethene) or PVC.

Draw a section of a PVC molecule containing four carbon atoms.

High Demand Questions

QUESTIONSHEET 6

Cracking is an important process in the petrochemical industry.

- (a) (i) What are the conditions for carrying out cracking?

.....
..... [2]

- (ii) Cracking can be demonstrated in the laboratory.
Draw a labelled diagram of an apparatus that would enable you to crack a sample of liquid paraffin and to collect the gaseous product.

[4]

- (iii) Give one piece of evidence that the product contains smaller molecules than the starting material.

..... [1]

- (b) The starting material is said to contain only saturated hydrocarbons, whereas the product will contain unsaturated ones. What is the difference between a saturated and an unsaturated hydrocarbon?

.....
..... [2]

Ethane is an alkane hydrocarbon.

(a) (i) Draw the structural formula of ethane.

[1]

(ii) Ethane is said to be saturated.
What does this term mean?

[1]

(iii) Why is it not possible to make polymers from ethane?

[1]

(b) Poly(butene) can be made from butene.

(i) Draw one possible structure of butene.

[1]

(ii) Draw a section of a poly(butene) having eight carbon atoms.

[1]

(c) poly(butene) is a thermosoftening plastic.
Other plastics may be described as thermosetting.

(i) Suggest one use for a thermosetting plastic.

[1]

(ii) Describe how a sample of a plastic could be tested to find out whether it is thermosetting or thermosoftening.

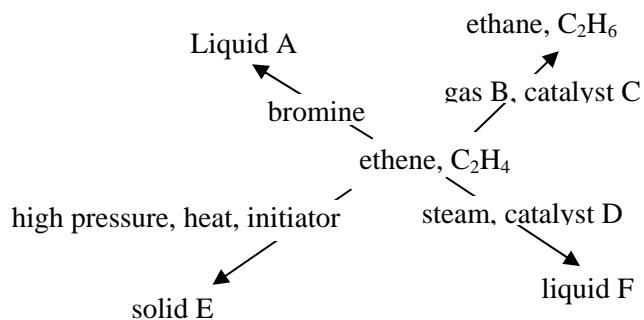
[3]

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High Demand Questions

QUESTIONSHEET 8

The diagram below shows some of the reactions of ethene, C_2H_4 .



(a) Give the names of each of the lettered substances.

(i) liquid A

.....

(ii) gas B

.....

(iii) catalyst C

.....

(iv) catalyst D

.....

(v) solid E

.....

(vi) liquid F

..... [6]

(b) Write a chemical equation for the reaction between ethene and steam to form liquid F.

..... [2]

(c) Ethene can be converted into ethane by reaction with gas B in the presence of catalyst C.

State one commercial application of this type of reaction.

..... [1]

The following table gives some data about the first ten members of the alkane homologous series.

name	formula	boiling point (°C)
methane	CH ₄	-161
ethane	C ₂ H ₆	-88
propane	C ₃ H ₈	-42
butane	C ₄ H ₁₀	0
(i)	C ₅ H ₁₂	36
hexane	C ₆ H ₁₄	69
heptane	C ₇ H ₁₆	
octane	(ii)	126
nonane	C ₉ H ₂₀	151
decane	C ₁₀ H ₂₂	174

(a) (i) Give the name of the alkane (i), C₅H₁₂.

..... [1]

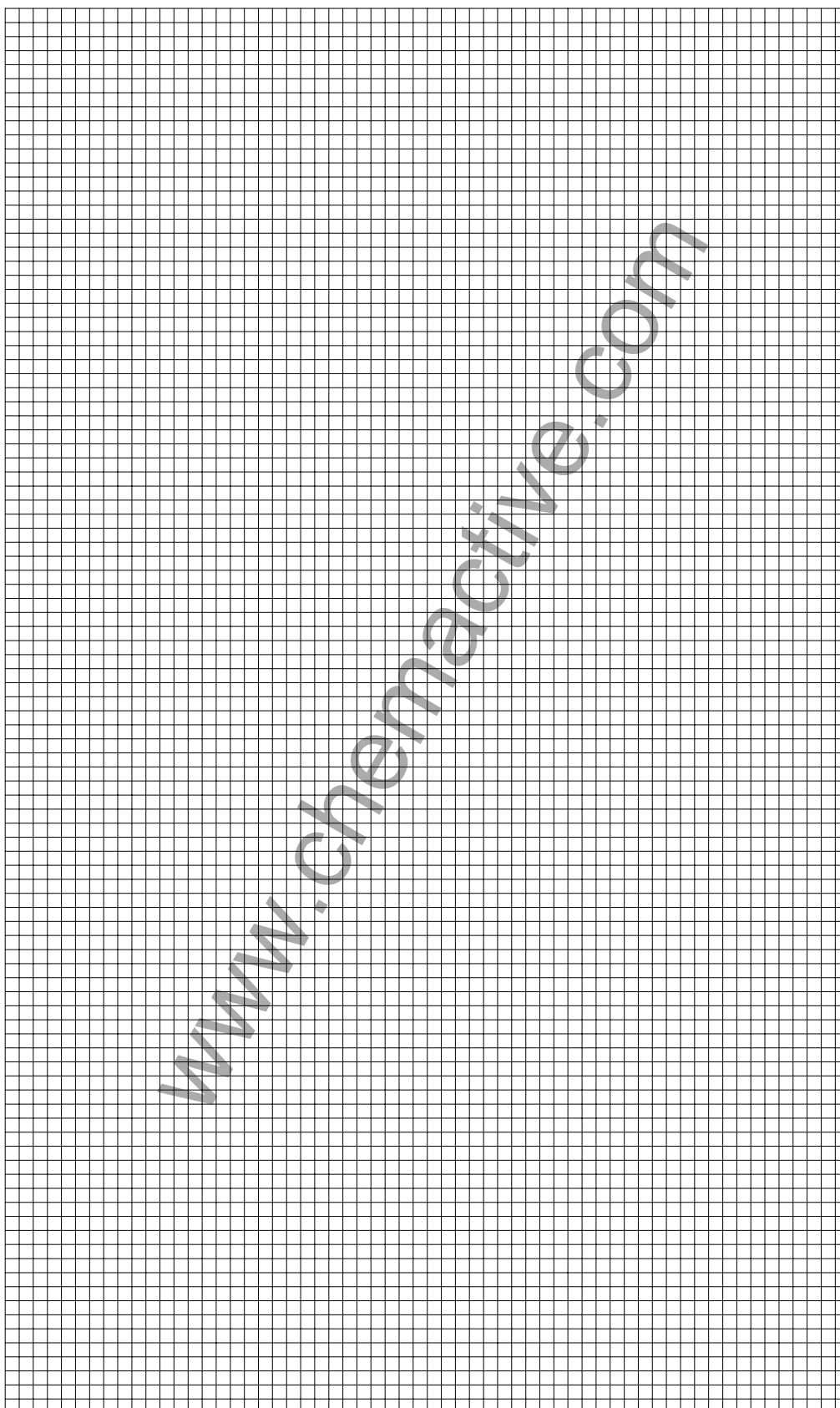
(ii) Give the formula of the alkane (ii), octane.

..... [1]

QUESTIONSHEET 9 CONTINUED

(b)(i) Plot a graph of boiling point (vertical axis) against number of carbon atoms (horizontal axis)

[4]



(Continued...)

QUESTIONSHEET 9 CONTINUED

(ii) Use the graph to estimate the boiling point of heptane.

..... [1]

(c) There are three hydrocarbons with the molecular formula, C_5H_{12} .

(i) Draw the structural formulae of all three hydrocarbons.

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[3]

Medium Demand Questions

QUESTIONSHEET 10

- (a) Ethene can be made into poly(ethene).
Draw a section of a poly(ethene) molecule containing at least six carbon atoms.

[2]

- (b) Poly(ethene) is a thermsoftening plastic.
Draw the structure of a thermsoftening plastic.

[2]

- (c) Explain why poly(ethene) is a good material for use in carrier bags.

.....
..... [2]

- (d) About thirty years ago, most carrier bags were made from paper, whereas most today are made from poly(ethene). Explain why this change has taken place.

.....
..... [2]

Medium Demand Questions

QUESTIONSHEET 11

The table below gives some information about monomers and the polymers that are made from them.

name and structure of monomer	name and structure of polymer
ethene $\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	poly(ethene) $\left[\begin{array}{cc} \text{H} & \text{H} \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]_n$
chloroethene $\begin{array}{c} \text{H} \quad \text{Cl} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	poly(chloroethene) $\left[\begin{array}{cc} \text{H} & \text{Cl} \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]_n$
phenylethene (ii)	(i) $\left[\begin{array}{cc} \text{H} & \text{C}_6\text{H}_5 \\ & \\ -\text{C} & - & \text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]_n$

(a) Complete the table. [2]

(b) What structural feature do these monomers have which enables them to be polymerised?

..... [1]

(c) Poly(chloroethene) is used to make coverings for electrical cables. It has replaced the use of rubber.

(i) State two properties of poly(chloroethene) that are common to plastics in general, and make it suitable for this use.

..... [2]

(ii) State **two** ways in which poly(chloroethene) is better than rubber for this use.

..... [2]

(d) Describe **two** environmental problems that are associated with the disposal of plastics.

..... [2]

The table below gives some information about monomers and the polymers that can be made from them.

monomer	structure	polymer	structure
ethene	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	poly(ethene)	$\left(\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ - \text{C} - \text{C} - \\ \quad \\ \text{H} \quad \text{H} \end{array} \right)_n$
propene	$\begin{array}{c} \text{H} \quad \text{CH}_3 \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	A	B
C	D	poly(tetrafluoroethene)	$\left(\begin{array}{c} \text{F} \quad \text{F} \\ \quad \\ - \text{C} - \text{C} - \\ \quad \\ \text{F} \quad \text{F} \end{array} \right)_n$

(a) Complete the table. [4]

(b) What is meant by the term 'monomer'? [1]

.....

(c) What is meant by the term 'polymer'? [2]

.....

.....

(d) Write down the molecular formula of tetrafluoroethene. [1]

.....

(e) Poly(ethene) can sometimes be used in place of steel. Give **one** advantage of using poly(ethene) in this way. [1]

.....

Medium Demand Questions

QUESTIONSHEET 13

- (a) To which homologous series does decane belong?

..... [1]

- (b) Cracking decane can produce the following products:

ethene C_2H_4

pentane C_5H_{12}

propene C_3H_6

Which of these are unsaturated?

..... [2]

- (c) Cracking decane can sometimes produce just two types of molecule.
If one of these products is ethene, give the formula and name of the other one.

- (i) formula

..... [1]

- (ii) name

..... [1]

- (d) What are the economic advantages of cracking?

..... [2]

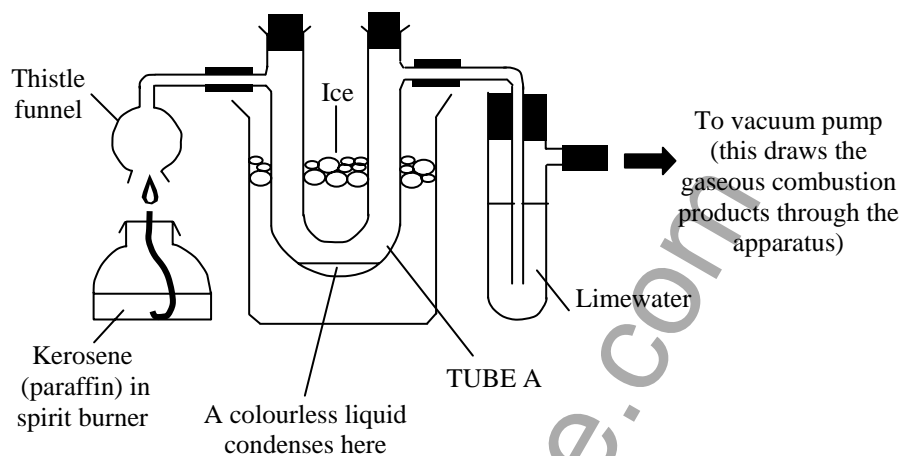
- (e) Name **two** chemicals that can be made from ethene.

..... [2]

Medium Demand Questions

QUESTIONSHEET 14

Some of the products of the distillation of crude oil are used as fuels.
To find out the products formed when hydrocarbons burn, the apparatus below is used.



- (a) Name the product collected in tube A.
..... [1]
- (b) What will happen to the limewater?
..... [1]
- (c) Some fuels leave a black deposit on the inside of the thistle funnel.
- (i) What is this deposit?
..... [1]
- (ii) Why does it form?
..... [1]
- (iii) What other product could be formed under these circumstances?
..... [1]

Medium Demand Questions

QUESTIONSHEET 15

Ethene can be used to make ethanol, C₂H₅OH.

- (a) Write an equation for this reaction.

..... [2]

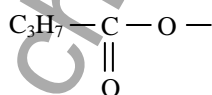
- (b) Ethanol can be used to make substances known as esters. Esters are often used as flavourings. The table shows some esters.

FLAVOURING	FORMULA OF ESTER
BANANA	$\text{CH}_3 - \underset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{O} - \text{C}_5\text{H}_{11}$
APRICOT	$\text{C}_3\text{H}_7 - \underset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{O} - \text{C}_5\text{H}_{11}$
PINEAPPLE	$\text{C}_3\text{H}_7 - \underset{\text{O}}{\underset{\parallel}{\text{C}}} - \text{O} - \text{C}_2\text{H}_5$

- (i) Which element is present in esters, which is not present in hydrocarbons?

..... [1]

- (ii) An ester found in apple flavouring contains five carbon atoms, ten hydrogen atoms and two oxygen atoms. Complete the formula of the apple flavouring given below.



[1]

- (iii) Many of the esters are used as flavourings in food additives.
Give **two** arguments for and **two** against the use of food additives.

.....

 [4]

(Continued...)

QUESTIONSHEET 15 CONTINUED

(c) Ethanol can be made from the fermentation of sugars. In Brazil, ethanol produced in this way is added to petrol. The mixture is known as Gasohol.

(i) Suggest why this is an economic process in Brazil, but would not be possible in Britain.

.....
..... [2]

(ii) Great care is taken in selling Gasohol.
What is the danger of making it too freely available?

..... [1]

(d) State another major use of ethanol.

..... [1]

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Medium Demand Questions

QUESTIONSHEET 16

- (a) Complete the table showing the names, molecular formulae and structural formulae of three compounds obtained from crude oil.

name	molecular formula	structural formula
butane	C_4H_{10}	
pentane		<pre> H H H H H H — C — C — C — C — C — H H H H H H</pre>
hexane		

[4]

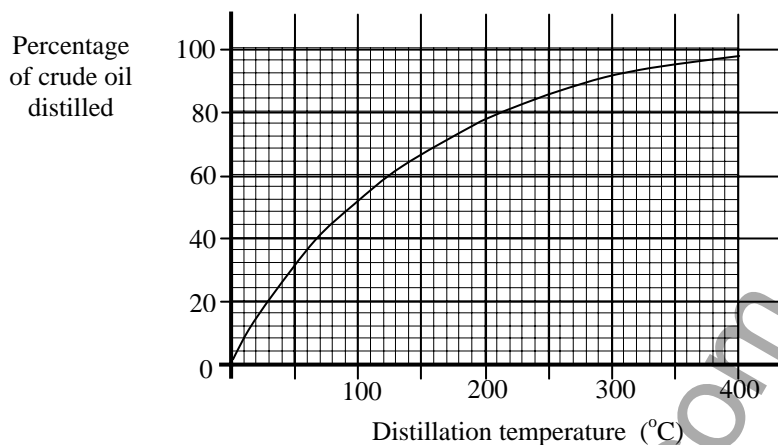
- (b) Butane is highly flammable.
Suggest **two** precautions which must be taken when storing it.

.....
..... [2]

- (c) Ethane boils at $-88^{\circ}C$ and ethene at $-104^{\circ}C$.
Why are they difficult to separate?

..... [1]

The graph shows the percentage of North Sea crude oil which distils off during fractional distillation at different temperatures.



(a) From the graph estimate the percentage which distils:

(i) below 20°C.

..... [1]

(ii) between 40°C and 75°C (petrol fraction).

..... [1]

(iii) between 75°C and 150°C (naphtha fraction).

..... [1]

(b) In what physical state would you expect the fraction below 20°C to be in?

..... [1]

(c) The table below gives the uses of the products from crude oil.

use	% of oil used
heating	44
road transport	37
generating electricity	8
making chemicals	

Calculate the percentage of crude oil used for making chemicals.

..... [1]

Detergents, paints and inks are all made from the components of crude oil.

(a)(i) What is a detergent?

..... [1]

(ii) Explain why it is important that detergents are biodegradable.

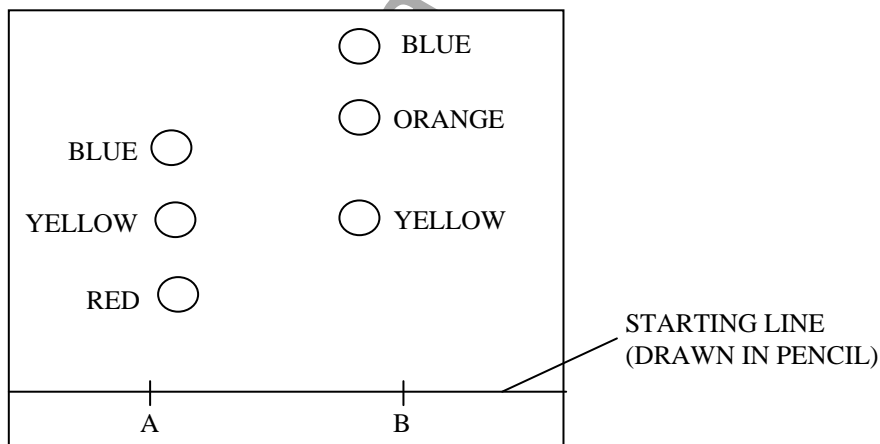
.....

 [2]

(b)(i) Inks are often mixtures of different coloured dyes.
 What technique could you use to prove this?

..... [1]

Ben and Jessica used this technique to compare the inks from different pens.
 Their results are shown below.



(ii) Why did they draw the starting line in pencil?

..... [1]

(iii) Which dye did the two inks both contain?

..... [1]

(iv) Which colour was only found in ink B?

..... [1]

Low Demand Questions

QUESTIONSHEET 19

- (a) The table shows some of the uses of plastics.
Complete the table by filling in the **best** reason for each use from the list below. The first one has been done for you.

REASONS - lightweight, does not conduct electricity, non-toxic, easily moulded, can be coloured, flexible.

use	best reason
coating for wires	does not conduct electricity
guttering	
carrier bags	
combs	
sandwich bags	

[4]

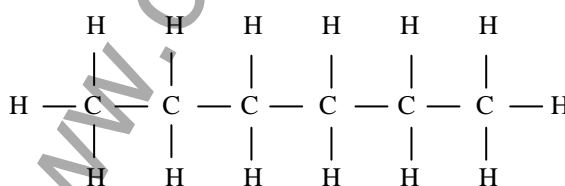
- (b) Crude oil, from which plastics are made, is first separated into fractions.
Information about some of the fractions is given in the table.

fraction	boiling range (°C)	number of carbon atoms
petroleum gas	-160 to 40	1 to 4
petrol	40 to 80	5 to 10
naphtha	80 to 150	8 to 12
kerosene	150 to 240	10 to 16

- (i) State a use for kerosene.

..... [1]

- (ii) In which fraction would this molecule be found?



..... [1]

- (iii) Propene has a boiling point of -47°C . In which fraction would propene be found?

..... [1]

Some fizzy drinks bottles are made from plastics.

There are a number of ways of disposing of waste plastic bottles.

Some are shown in the table below.

option	method
A	burn them with other household rubbish
B	fill in quarries with household waste
C	re-use the bottles
D	make them into pellets of pure plastic

- (a) Which **two** of the options help to conserve oil reserves?

..... [1]

- (b) Describe environmental problems which could be caused by options A or B.

- (i) Option A

..... [2]

- (ii) Option B

..... [2]

- (c) In option C, the bottles would need to be sterilised before being re-used.

Glass bottles are sterilised using superheated steam.

Why might this be unsuitable for plastic bottles?

..... [2]

- (d) What could be done with heat produced in option A?

..... [1]